(12) UK Patent Application (19) GB (11) 2 188 739 (13) A

(43) Application published 7 Oct 1987

(21) Application No 8608339

(22) Date of filing 4 Apr 1986

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(51) INT CL[4]
G01L 1/20

(52) Domestic classification (Edition I):
G1W E3A1C E3D1 E3D611X G2 GX

(56) Documents cited
EP A1 0166168 US 4616723 US 3771359
EP A1 0144494 US 4546838 US 3696317
Note: EP A1 0166168 and US 4616723 are equivalent;

(58) Field of search
G1W
Selected US specifications from IPC sub-classes G01G G01L

(54) Weight monitoring device

(57) A reaction monitoring device (10) for monitoring the weight of large structures during fabrication comprises a pair of transverse beams (12,14) having a load bearing portion (20) defined at the intersection thereof and supporting feet (18) located at either longitudinal end. Strain gauges (22,24,26,28) are positioned on the sidefaces of the beams (12,14), each comprising a wire-resistance shear pair electrically connected in a Wheatstone bridge circuit such that the device is responsive substantially to shear strain only, side-loading and thermal expansion effects etc being balanced in the bridge circuit.

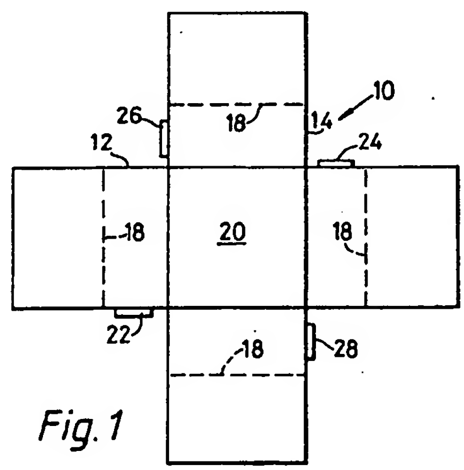

Fig. 1

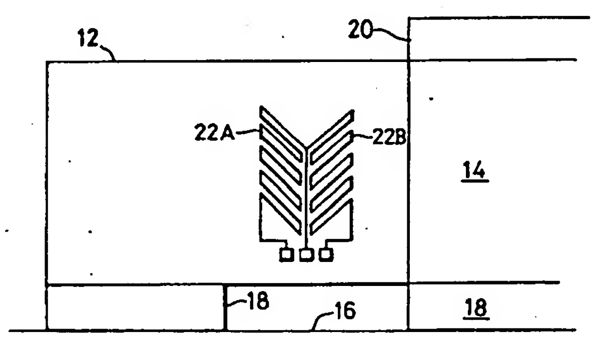

Fig. 2

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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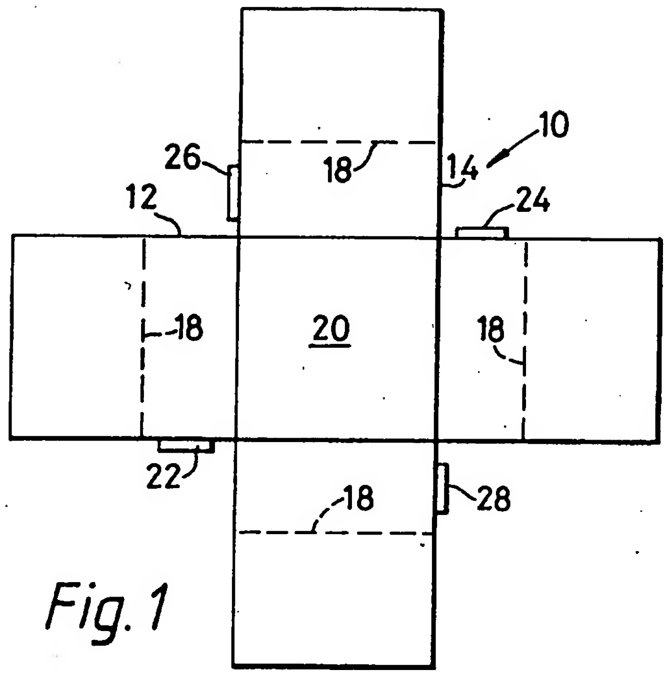


Fig. 1

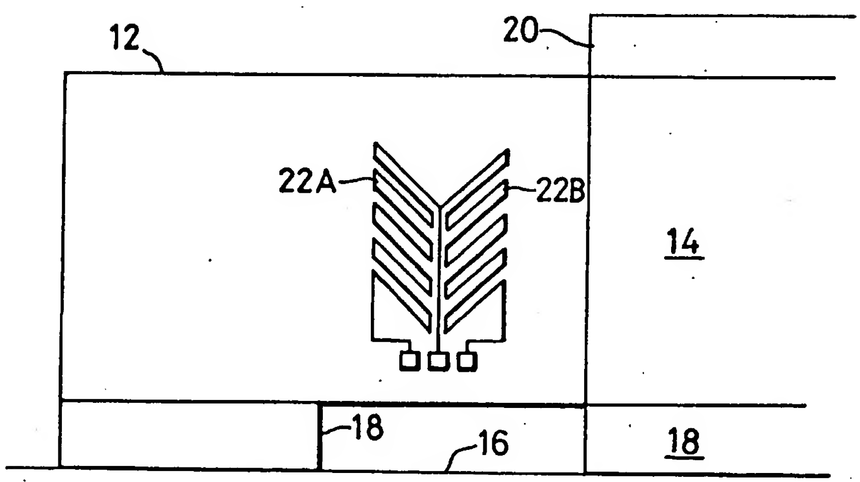


Fig. 2

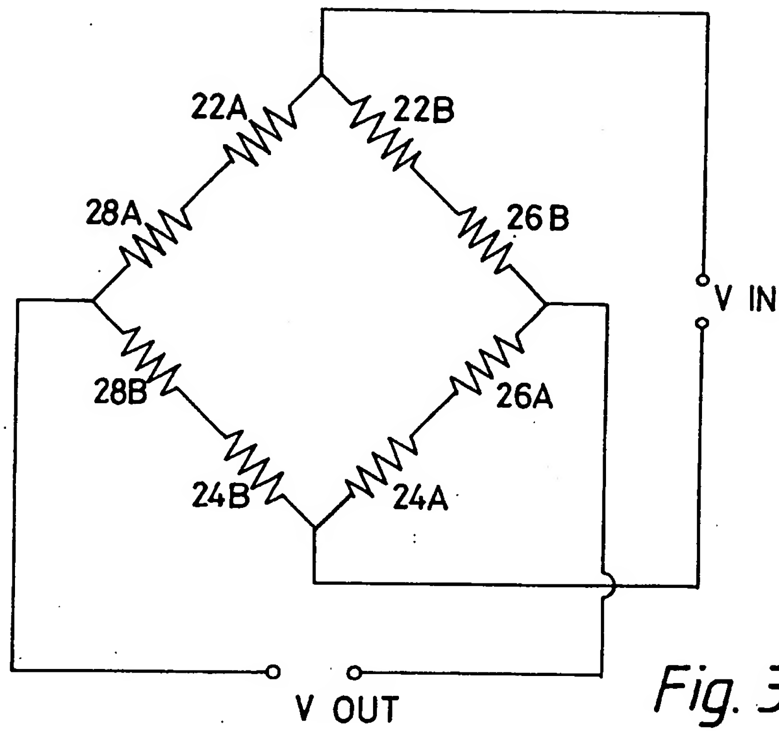
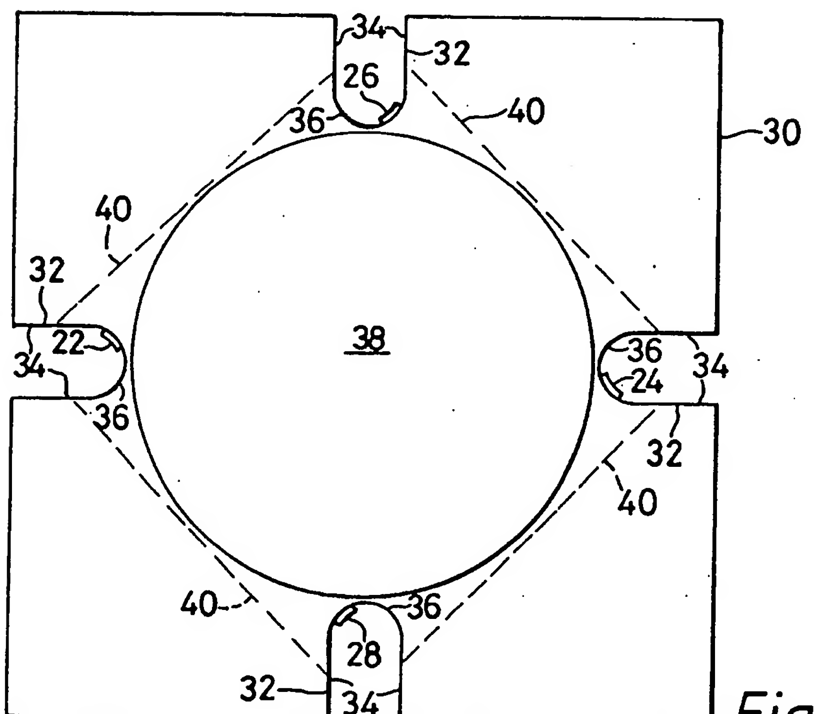

22A
22B
28A
26B
V IN
28B
26A
24B
24A
V OUT

Fig. 3


34
32
26
36
40
30
40
32
22
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38
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34

Fig. 4

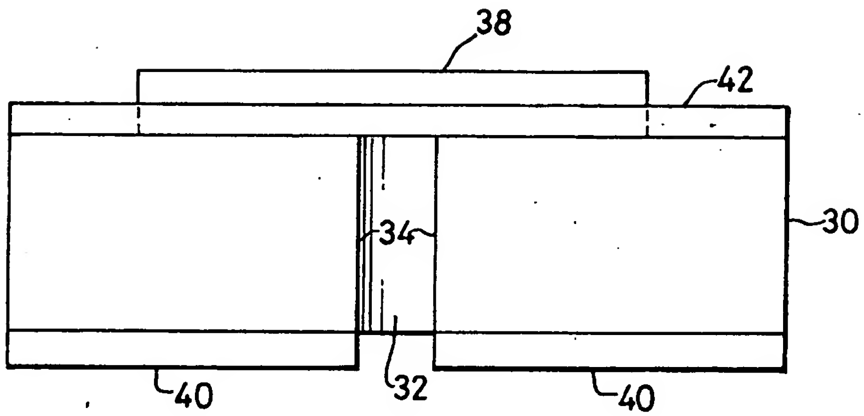

Fig. 5

SPECIFICATION

Reaction monitoring device

Description

The present invention relates to a reaction monitoring device for weight measurement and is particularly intended for use in monitoring the weight of large structures during fabrication.

Conventionally, monitoring of this kind has been carried out by jacking-up the structure under construction using combined jack/load cells. This is obviously time consuming and necessarily disruptive to the fabrication work.

Other problems encountered in accurately monitoring the weight of such structures during fabrication include side load effects, induced by off-centre loading and thermal expansion/contraction of the structure during yearly temperature cycles, and the effects of electric welding currents earthing through the monitoring device.

Additionally, conventional load cells exhibit a non-linear load/strain relationship, necessitating calibration for both low and normal load ranges, and produce a small output signal requiring subsequent amplification which is consequently subject to distortion by electrical noise common in a welding construction environment.

It is an object of the present invention to obviate or mitigate the above mentioned disadvantages.

Accordingly, the present invention provides a reaction monitoring device comprising at least two intersecting transverse beams, each of said beams being provided with support means located adjacent either longitudinal end thereof to maintain said beams clear of a supporting surface, and having a load-bearing surface located at the intersection thereof, each of said beams being further provided with first and second shear strain gauge means located on opposite sides thereof between said load bearing area and said support means.

Preferably, said shear strain gauge means each comprise a shear pair having a positive and a negative shear component.

Preferably also, said shear strain gauge means are connected in a Wheatstone bridge circuit such that said first and second gauge means of each of said beams are opposite one another in said bridge circuit.

Preferably also, each arm of said bridge circuit includes first and second components being one each from two of said shear strain gauge means, said first and second components being either both positive or both negative shear components.

Preferably also, adjacent arms of said bridge circuit include components of opposite sign.

Preferably also, said shear strain gauge means are located at the vertical mid-point of the side faces of said beams.

In a particularly preferred embodiment, the device includes a generally square planar member having a notch in the middle of each of its four sides thereby defining first and second transverse diagonal beams.

Preferably, said load bearing surface and said support means are made from electrical insulating material.

Preferably also, said load bearing surface comprises a circular plate and said support means comprise generally triangular feet located at the corners of said square member.

Preferably also, said notches each include first and second parallel side-walls extending inwardly towards the centre of said square member and closed at their innermost ends by a semi-circular end-wall, said strain gauge means being located on said end-wall at a point where the tangent to the semi-circle is parallel to a diagonal axis of the square member.

Preferably also, the top surface of said square member surrounding said load bearing surface is also covered by insulating material.

Preferably also, said beams are made from steel (preferably BS 4360 50D) and said insulating material is nylon or plywood.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a schematic plan view of a device embodying the invention;

Figure 2 is a fragmentary end elevation of the device of Fig. 1;

Figure 3 is a circuit diagram showing the electrical connection of the strain gauges of the device of Figs. 1 and 2;

Figure 4 is a plan view of a particularly preferred embodiment of the invention; and

Figure 5 is an end elevation of the embodiment of Fig. 4.

Referring now to Fig. 1 of the drawings, a reaction monitoring device 10 is based upon a core of non-compressible material, such as steel, which is generally cross-shaped, comprising a pair of intersecting transverse beam members 12 and 14. The core is maintained clear of a supporting surface 16 (Fig. 2) by support means such as feet 18 located at either longitudinal end of each of the beams 12 and 14 and a load bearing surface is defined at the intersection of the beams 12, 14 by a raised planar portion 20.

The device 10 is provided with strain gauge means 22, 24, 26, 28, each of said beams 12 and 14 having one of said strain gauges located on either longitudinal side surface thereof between the feet 16 and the raised load bearing portion 20. As is best seen in Fig. 2, each of the strain gauge means 22, 24, 26, 28 comprises a 45°, wire-resistance shear pair which consists of a positive shear component, such as 22A, and a negative shear component, such as 22B. The gauges

22, 24, 26, 28 are preferably located at the vertical mid-point of the side faces of the beams 12, 14 (the size of the gauge 22 is exaggerated for clarity in Fig. 2).

As shown in Fig. 3, the strain gauges 22, 24, 26 and 28 are connected in a Wheatstone Bridge-type circuit such that the pairs of gauges located on each of the beams 12 and 14 (i.e. 22, 24 and 26, 28) are opposite one another in the circuit and each arm of the bridge includes either two positive shear components 22A, 24A, 26A, 28A or two negative shear components 22B, 24B, 26B, 28B, adjacent arms having components of opposite sign.

The arrangement of the gauges 22, 24, 26, 28 on the core and their electrical connection in the bridge circuit ensures that the device responds to shear strain only. Other strain effects resulting from thermal expansion, torsion, side-loading, etc. balance one another in the bridge and do not affect the output signal Vout. On the other hand, the shear strain arising from a weight acting on the load bearing portion 20 will cause the resistance of the positive shear components 22A, 24A, 26A, 28A to increase and that of the negative shear components 22B, 24B, 26B, 28B to decrease so that the bridge circuit becomes progressively more unbalanced, and hence Vout increases, as the weight acting on the device increases. Since the device is sensitive to pure shear strain only, the inherent linearity of shear stress/strain relationship is preserved, simplifying calibration. Furthermore, the signal obtained is sufficiently large that no further amplification is needed, reducing the sensitivity of the device to distortion caused by electrical noise in the operating environment.

Figs. 4 and 5 illustrate a particularly preferred embodiment of the invention wherein the core of the device comprises a generally square planar member 30 having a notch 32 located at the mid-point of each side and extending inwardly towards the centre, thereby defining a pair of transverse diagonal beams.

As shown, each of the notches 32 comprises a pair of parallel side-walls 34 closed at their innermost end by a semi-circular end-wall 36. The strain gauges (again numbered 22, 24, 26, 28 for ease of comparison with Figs. 1 to 3) are located on the end-walls 36 at a point where the tangent to the semi-circle is parallel to a diagonal axis of the core member 30.

The load-bearing surface is a circular plate 38 located at the centre of the core member 30 and the feet 40 are located at the corners thereof, being generally triangular so as to cover as large an area as possible without impinging on the area of the circular plate 38. The plate 38 and feet 40 are preferably of a non-compressible insulating material, such as nylon or plywood so as to prevent welding currents in the work-piece earthing through the device. The core member 30 itself is preferably of BS 4360 50D steel.

The remaining top surface of the core member 30 around the plate 38 can also be covered by a layer of insulating material 42 (Fig. 5).

Obviously, the particular shape of the core of the device can be widely varied, and more than two transverse beams may be employed. The measuring range of the device can also be varied by altering the core thickness.

In use, the work-piece is supported on a plurality of the devices so that its total weight, centre of gravity etc can be monitored through-out the construction period.

CLAIMS

1. A reaction monitoring device comprising at least two intersecting transverse beams, each of said beams being provided with support means located adjacent either longitudinal end thereof to maintain said beams clear of a supporting surface, wherein a load-bearing portion is located at or adjacent to the intersection of said beams and wherein each of said beams is provided with first and second shear strain gauge means located on opposite sides and adjacent opposite ends thereof between said load-bearing portion and said support means, said strain gauge means being so arranged and electrically connected that the device is responsive substantially to shear strain only.

2. A device as claimed in claim 1 wherein said shear strain gauge means each comprises a shear pair having a positive and a negative shear component.

3. A device as claimed in claim 2 wherein said shear strain gauge means are connected in a Wheatstone bridge circuit such that said first and second strain gauge means of each of said beams are opposite one another in said bridge circuit.

4. A device as claimed in claim 3 wherein each arm of said bridge circuit includes first and second components being one each from two of said shear strain gauge means, said first and second components being either both positive or both negative shear components.

5. A device as claimed 4 wherein adjacent arms of said bridge circuit include shear components of opposite sign.

6. A device as claimed in any preceding claim wherein said shear strain gauge means are located at the vertical mid-point of the side faces of said beam.

7. A device as claimed in any preceding claim wherein said load-bearing portion is provided with a generally planar member defining a raised load-bearing surface.

8. A device as claimed in claim 7 wherein said planar member and said support means are made from electrical insulating material.

9. A device as claimed in any preceding claim comprising a generally square planar

member having a notch formed in the middle of each of its four sides, thereby defining first and second transverse diagonal beams.

10. A device as claimed in claim 9 wherein a raised load bearing surface is defined by a circular plate positioned at the centre of the top surface of said square member between said notches.

11. A device as claimed in claim 10 wherein the top surface of said square member surrounding said circular plate is covered by electrical insulating material.

12. A device as claimed in any of claims 9, 10 or 11 wherein said support means comprises generally triangular feet located at the corners of said square member.

13. A device as claimed in any of claims 9 to 12 wherein said notches each include first and second substantially parallel side-walls extending inwardly towards the centre of said square member and closed at their innermost ends by a semi-circular end-wall, said strain gauge means being located on said end-wall at a point where the tangent to the semi-circle is substantially parallel to a diagonal axis of the square member.

14. A device as claimed in any preceding claim wherein said beams are made from steel.

15. A device substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.